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INTERNATIONAL STANDARDS RELATED TO TIMBER CONSTRUCTION*

(ISO/TC 165)**

by

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1. INTRODUCTION

In the following a survey is given of the work of ISO's Technical Committee 165, Timber Structures. This committee is the most important one regarding wood structures, although the work of other ISO committees as well is of great importance, e.g.

- ISO/TC 55, Sawn Timber and Sawlogs, dealing with standardization of sawlogs, sawn timber and test methods of mechanical properties of wood
- ISO/TC 98, Bases for Design of Structures, dealing with terminology and symbols, actions on structures, limitations of deformations and consideration and coordination of basic safety requirements, irrespective of the material of construction
- ISO/TC 89, Panel Products, dealing with standardization of fibre building boards, particle boards and plywood including nomenclature specifications and test methods.

The primary aim of ISO is to work out international standards. This is carried out in technical committees (TC's), headed by a chairman, with the support of a technical secretary assigned to an ISO member body.

Chairman and secretary can exert a great influence on the progress of the work in a technical committee, but it is the members, especially the so-called P-members (Participating members), who determine the tasks to be taken up, their solution, the contents of the technical documents etc.

The work in ISO/TC 165 is dominated by Australia, Canada and a number of West European countries. With a few exceptions owing to Australia, it is the need, the building traditions and technical level of these countries, that are covered by the standards which are already published or under production. To make the documents cover the need of developing countries as well, a certain adaptation will in most cases be necessary; in some areas they should be extended, in others simplified.

The purpose of this paper is to form a basis for discussion as to how such an adaptation could be carried out.

Till now the work in ISO/TC 165 has been aimed at preparation of standards in three main areas:

- testing
- materials and products, and
- timber design.

These are going to be discussed in the following sections.

At the latest meeting, in 1984, it was decided to expand the working programme with the topic Safety of Timber Structures in Relation to Biological Attack. The first task will be to prepare a standard on categories of biological hazards to timber structures and classes of timber species, both natural and chemically treated.

The basis for ISO's standards is normally preliminary work, carried out in a number of international organizations; in the wood area especially CIB* and RILEM**.

2. TEST STANDARDS

Especially for wood, where the strength- and stiffness values found by testing are greatly dependent on duration of load, moisture content and load arrangement, it is essential that the methods for testing materials, joints and structural elements are standardized. Therefore one of the first tasks of the committee was the preparation of test standards.

The following international standards are available:

- ISO 6891, Timber Structures - Joints made with mechanical fasteners - General principles for the determination of strength and deformation characteristics,
- ISO 8375, Solid Timber in Structural Sizes - Determination of some physical and mechanical properties.

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* Conseil International du Bâtiment pour la Recherche l'Etude et la Documentation

** Réunion Internationale des Laboratoires d'Essais et de Recherches sur les Matériaux et les Constructions

ISO 6891 indicates the general principles for load application, determination of load-slip curves, presentation of test results etc. It will be supplemented with standards for a number of specific fasteners with indication of special conditions to be considered.

Provisional proposals for such supplementary standards for joints with nail plates, nails and staples are available, and standards for bolts are in preparation.

ISO 8375 indicates how to determine the following properties: Moisture content; density; modulus of elasticity in bending, tension, compression and shear; strength in bending, and tension and compression parallel to the grain. Not covered are shear, and stiffness and strength perpendicular to the grain.

In cooperation with ISO/TC 89 a standard with test methods for the determination of physical and mechanical properties of plywood for structural purposes is almost finished, and testing standards for other panel products (fibre board, particle board) are in preparation.

Furthermore, standards for testing of structural elements and of whole constructions are in preparation.

3. MATERIAL- AND PRODUCT STANDARDS

In this area there are three main subjects:

- Structural grouping of solid timber and poles
- Grading rules and rules for the production and control of finger jointed timber
- Rules for the production and quality control of glued laminated timber.

(a) Structural grouping

This work has been initiated by Australia. The background is as follows:

The number of species utilized throughout the world runs into several thousands, and for each species several grades are available. It is obviously not feasible to be concerned with special strength and stiffness values for each grade of each species. To avoid this difficulty, the technique of structural grouping is employed: The true properties of all timbers are replaced by hypothetical properties related to a small set of strength classifications. Thus the user only has to be concerned with a small set of hypothetical properties; and the concern of the supplier is to classify his timber into the appropriate class of the set.

Because the user is concerned only with designing to a set of hypothetical properties, he is not directly affected by any changes that might occur at the source of timber supply, whether this be local or imported. If a new timber or new grade of timber is introduced into commercial use, it is simply fitted into the appropriate strength classification and no new designs are necessary for it to be utilized.

It is obvious that structural grouping leads to some loss in efficiency in the utilisation of particular timber because of differences between the true and group specified properties. Structural grouping is therefore especially appropriate for species and qualities of wood not commonly used and adequately documented as to their strength and stiffness properties. For commonly used species and grades (e.g. Nordic spruce and fir, many North American softwoods, and Radiata pine) it is more appropriate to give special strength profiles.

Two bases are used for grouping: Density grouping and Grade class grouping, the latter based on the structural properties of commercially graded timber containing natural defects. For the grade classes strength profiles as shown in table 1 are assumed.

able 1 - Characteristic values related to grade class, for solid timber. All values in MPa.

grade class	f_m	$f_{t,0}$	$f_{c,0}$	f_v	E_o
T75	75.0	48.0	60.0	6.0	12 000
T60	60.0	38.0	48.0	4.8	10 500
T48	48.0	30.0	38.0	3.8	9 500
T38	38.0	24.0	30.0	3.8	8 500
T30	30.0	19.0	24.0	3.0	7 500
T24	24.0	15.0	19.0	2.4	6 000
T19	19.0	12.0	15.0	2.4	5 400
T15	15.0	9.5	15.0	1.9	4 800
T12	12.0	7.5	12.0	1.9	3 800
T10	9.5	4.8	9.5	1.5	3 400
T8	7.5	3.8	9.5	1.2	3 000
T6	6.0	3.0	7.5	1.2	2 700
T5	4.8	2.4	6.0	0.95	2 400

f_m : bending strength

$f_{t,0}$: tension strength parallel to grain

$f_{c,0}$: compression strength parallel to grain

f_v : shear strength

E_o : modulus of elasticity parallel to grain

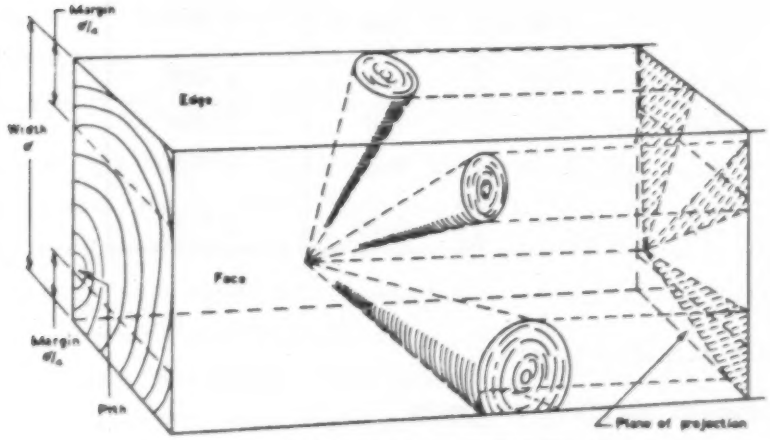
(b) Grading and finger-jointing

The standard on grading is based on the grading rules laid down by the ECE* Timber Committee, and the task for ISO/TC 165 is to convert these rules into international code format.

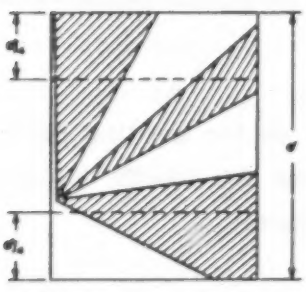
* Economic Commission of Europe

The ECE grading rules have been developed on the basis of European redwood and whitewood, but can be used directly for most softwoods. For hardwoods they are generally unsuitable.

The main grading factor is knots, where the ECE rules are based on the so-called knot area ratio. These knots are assessed by the total knot area and the margin knot area. The total knot area is the ratio of the sum of projected cross-sectional areas of all knots intersected by any cross-section to the total cross-sectional area of the piece (see figure). The margin knot area is the ratio of the sum of the projected cross-sectional area of all knots or portions of knots in a margin intersected at any cross section to the cross-sectional area of the margin.



(a) Axonometric view showing in three-dimension a group of knots in a piece and their projection on a cross-sectional plane



(b) Front view of projection plane, showing projection of knots (hatched)

Edge, faces and margin areas. Knot projection.

The standard on finger jointing is also based on recommendations prepared by the ECE Timber Committee and especially aimed at finger joints in softwood.

(c) Standards for glued laminated timber

Three working drafts have been prepared, covering production requirements, delamination tests and shear block tests. The working drafts were based on the production technique used in West Europe, based on European redwood and whitewood and aiming at a high quality product.

At its last meeting ISO/TC 165 decided to set up a working group to investigate the possibilities of a more general approach, based on the performance requirement concept, and to let further work on the above mentioned standards await the result of these investigations.

4. DESIGN STANDARD

The most ambitious task of the ISO/TC 165 is the preparation of an international standard for the design of most timber structures together with the construction rules necessary for the applicability of these design rules. The dimensions of this task are without precedent in ISO.

The primary purpose of the ISO design standard is to provide an agreed background for the national committees and international bodies responsible for the formulation of timber design standards. Thus it is not a question of a standard which can be used directly in design practice.

Among others, the detailed assessment of actions, safety system and safety factors is missing - as to these topics reference is merely made to the general ISO 2394, General principles on reliability for structures - and for a great number of parametres (e.g. for the effect of load duration and moisture content on strength and stiffness, and the dependence of joint strength on wood properties) only practical applications are given. In an operational standard it is necessary to give precise values for these parameters.

The present draft to an ISO standard has been utilized by the EEC* as basis for a Eurocode** on wood constructions, and it has proved feasible to transform the ISO standard to an operational norm.

The contents of ISO standards are shown in Annex 1, and correspond broadly to the contents of CIB Structural Timber Code, worked out by CIB Working Commission W18 and published in CIB Report 66, 1983. However, a number of editorial changes has been made, and certain sections have been revised due to new knowledge, this applies e.g. to the section dealing with calculation of strength shear of beams.

The largest section is section 8, Design, which is subdivided in Basic members, Components and Joints.

The section on basic members deals with:

- straight beams; tapered beams; double-tapered beams; curved beams; cambered beams,

made of

- solid timber and glued laminated timber

exposed to

- tension and compression (with and without column effect) parallel to the grain; tension and compression perpendicular to the grain; bending (inclusive of failure by lateral instability); shear; torsion; combined stresses.

The section on components deals with:

- glued thin-webbed beams (I-beams, box-beams); glued thin-flanged beams (stiffened plates, stress-skin elements); glued I- and box-columns, spaced columns and lattice columns; mechanically jointed components; trusses.

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* European Economic Community

** The Commission of the European Communities is drawing up a series of codes for the calculation of structures in the building and civil engineering sectors in the Community. These EUROCODES are intended to provide engineers and contractors with a set of rules of unified conception for the calculation and erection of structural elements and buildings.

The section on joints treats in detail nails, bolts and screws and gives general rules for assessment of connectors, however, not detailed rules for proprietary connectors (split-ring, shear-plates, toothed plates etc).

The sections on basic members and components could be simplified and abbreviated essentially, influencing the necessary detailing of other sections as well. It could be done by concentrating on the most general structures and just in few cases give more specific rules of construction (the section on design against lateral instability might for instance be replaced by rules for maximum heigth/width conditions and requests for sideways bracing).

5. STANDARDS FOR DEVELOPING COUNTRIES

As mentioned in the introduction, most of the standards in question are aimed at the needs of the industrialized countries. This goes especially for the Timber Design Standard.

The necessary adaptation can be carried out in ISO/TC 165, but will imply both that the other members accept the issue of parallel standards, and that the interested countries take an active part in the work through their standardization organisations. It will in any case be a slow process.

Another way - and perhaps a more appropriate one - might be trying to solve the problem in direct cooperation among the interested countries, assisted by the secretariat of ISO/TC 165 and supported by UNIDO.

Annex 1

List of contents of
Draft for an ISO Standard on DESIGN OF TIMBER STRUCTURES

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